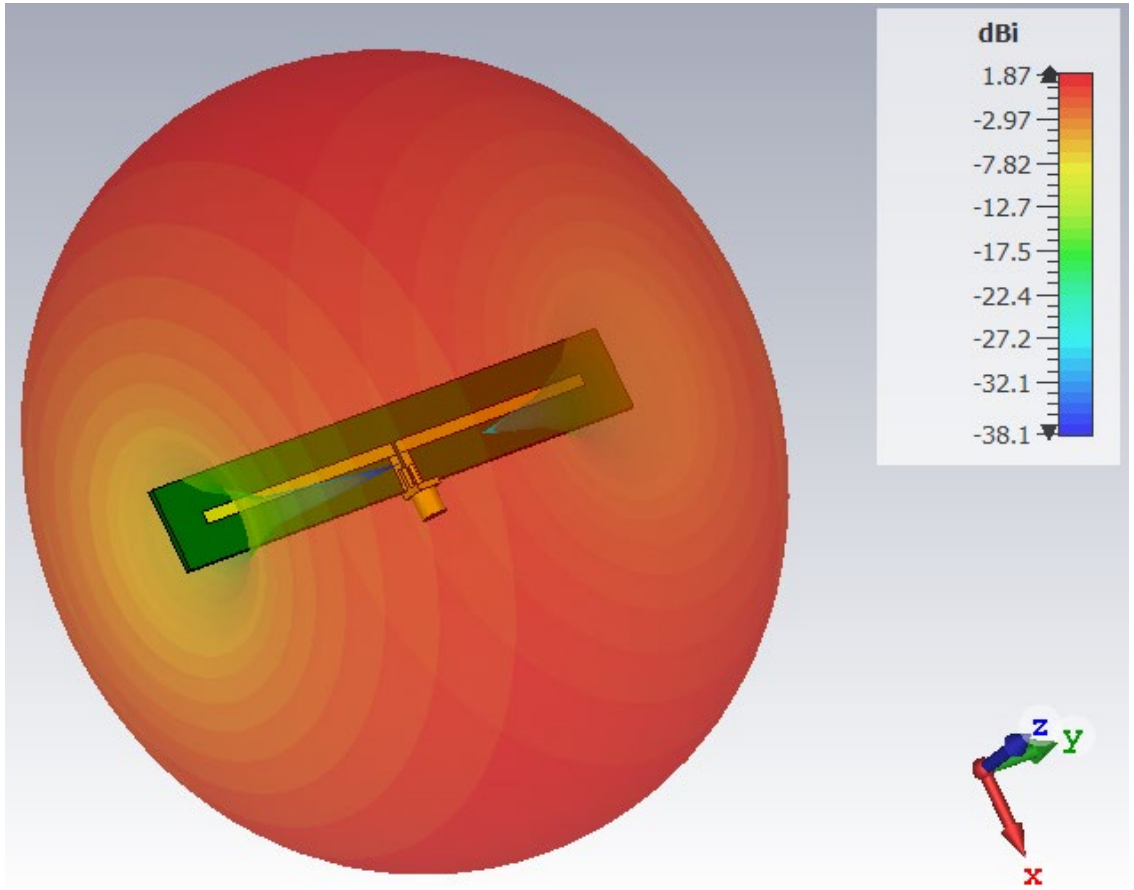
Technische Universiteit
Eindhoven
University of Technology

Lab session 3

Measurements of antennas

Where innovation starts

Radiation pattern

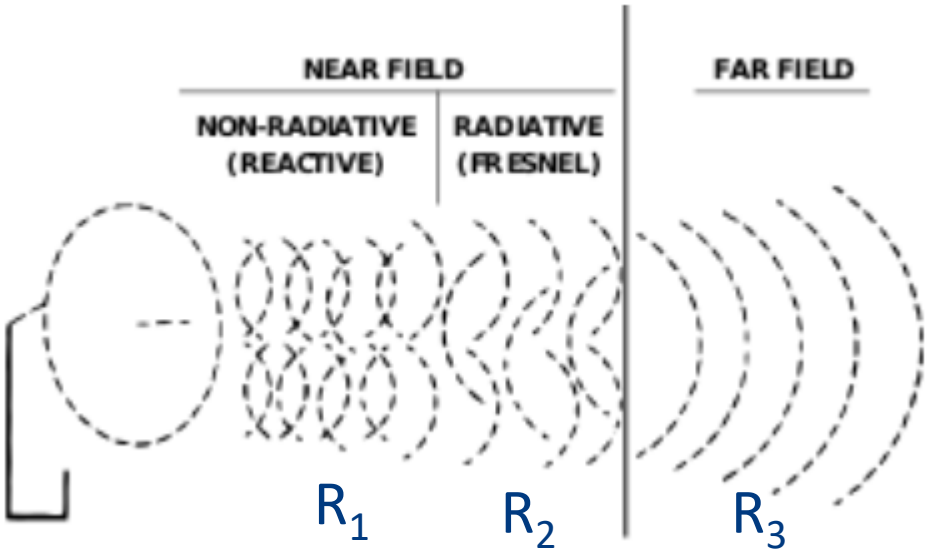


Realized gain

$$G = \eta D$$

G = Gain
η = Radiation Efficiency
D = Directivity

Field Regions



Regions R_1 , R_2 , R_3 can be expressed as:

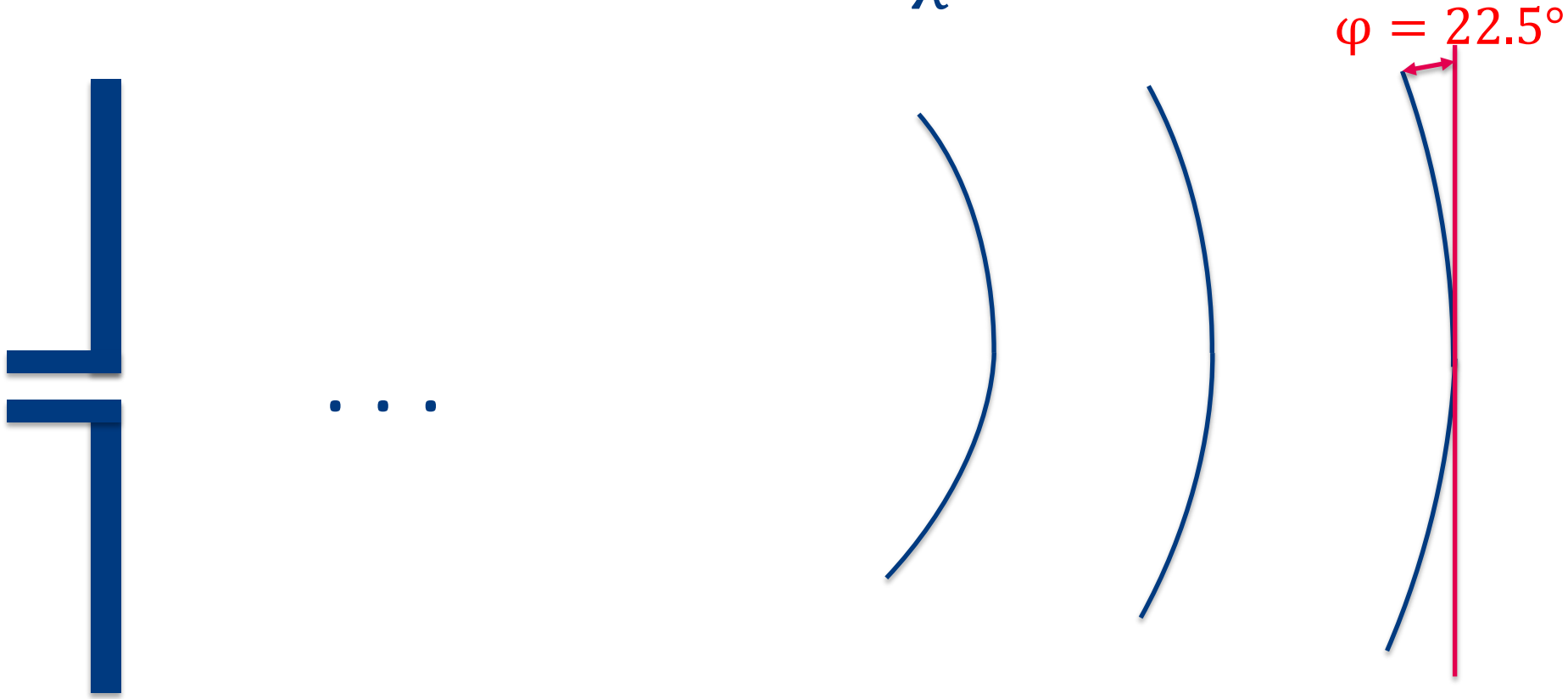
$$R_1 < 0.62\sqrt{\frac{D^3}{\lambda}}$$

$$0.62\sqrt{\frac{D^3}{\lambda}} < R_2 < \frac{2 \cdot D^2}{\lambda}$$

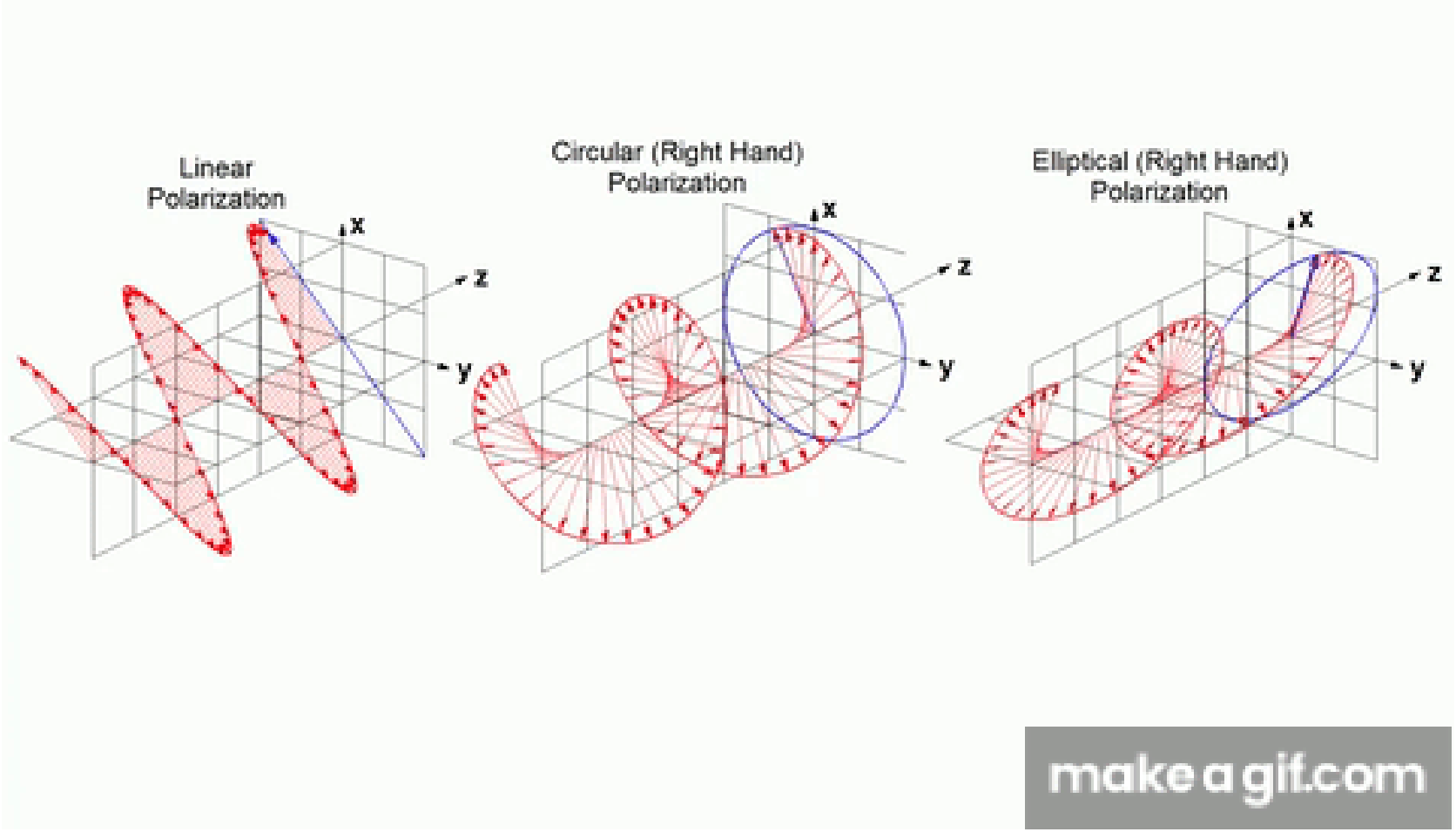
$$R_3 > \frac{2 \cdot D^2}{\lambda}$$

Far Field

$$Far\ Field\ Distance \geq \frac{2D^2}{\lambda}$$ (rule of thumb)

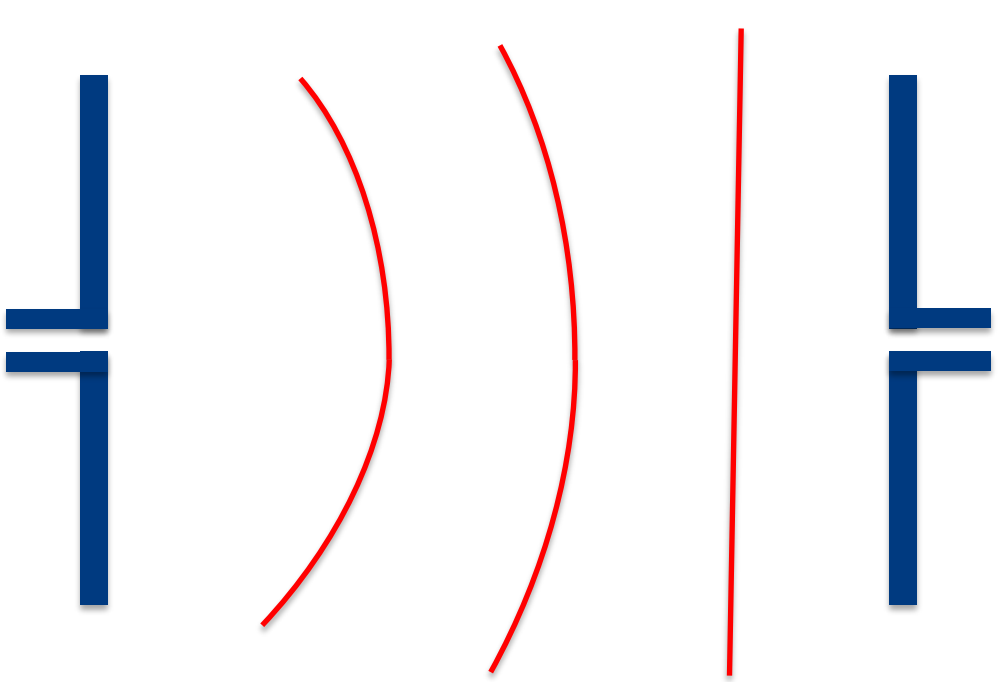


Polarization

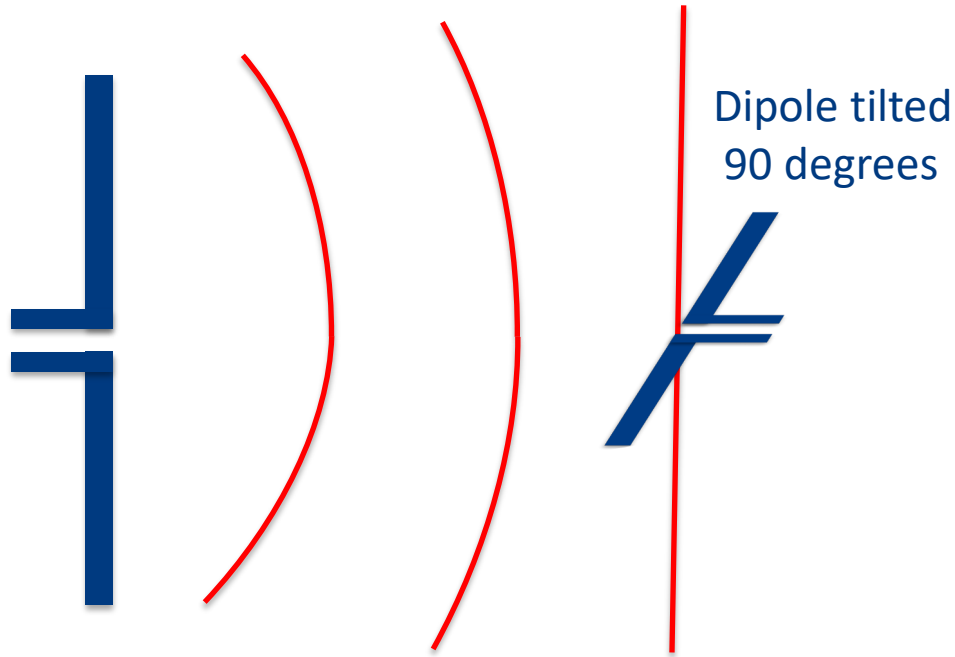


Polarization

For ideal transmitting and receiving, the incoming field should be polarized the same as the antenna (co-polarization). The worst case is cross polarization.



Co-polarization



Cross-polarization

Measuring your antenna

- Calibrate your NanoVNA (see slides lab session 2 and slides on NanoVNA)
  - Choose frequency from 400 MHz – 1500 MHz (same as CST models)
  - Check your calibration!
- Connect a dipole to port 1, make sure NO objects are in the near-field of the antenna and save all your measurement data.
  - Check the S_{11}, what is the percentage of the power transferred from the NanoVNA to the antenna?
  - Bring one of your hands close to the antenna, do the results change? Why?
  - Compare your measured results with your simulated results. Are there differences? Why?

Measuring your antenna

- Connect a second dipole to port 2, check the following configurations and measure the S21
  - Think in terms of antenna alignment. If you look at the simulated 3D radiation pattern, where does the antenna radiate the most and least energy? Can you think of a best and worst transmission in terms of antenna alignment? Verify this with measurements.
  - Think in terms of the polarization, what configuration would be ideal and what configuration would be the worst in terms of maximum transmission? Verify this with measurements.
- Take a fixed antenna distance and extract the antenna gain by solving the Friis equation. Is this different from the simulated gain? Why?